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AMPHIBIOUS OPERATIONS IN A MINE ENVIRONMENT
A CLEAR PATH TO THE BEACH....UNMARKED

by

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A Research Report Submitted to the Faculty

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Preface

I began this research project with the idea of researching and writing about a shortfall within the Department of the Navy concerning mine countermeasures (MCM) readiness. Having completed tours of duty in Avenger-Class mine countermeasures ships, deploying to NATO in support of coalition operations, and being an Explosive Ordnance Disposal technician, I felt that it would be natural to research a topic with which I was operationally familiar.

After starting a review of basic foundation references such as *Forward...From the Sea*, *Operational Maneuver from the Sea*, and *Ship to Objective Maneuver*, I came to the realization that the real problem was not a mine countermeasures shortfall. In fact, despite the current limitations and struggles to restore the MCM force after the lessons of the Gulf War, I found a shortfall in amphibious lane marking capabilities that was more critical and less known than the MCM deficiencies. Perhaps it is easier to reveal discrepancies already known than to uncover new shortfalls.

My goal for the paper is limited. In an era of reduced defense budgets and readjustment of the force to the post Cold War threat, there is a myriad of papers espousing critical shortfalls – with an urgent call for the corresponding cure. I hope to raise the level of attention to this deficiency in amphibious lane marking because the shortfall transcends the naval service. It is my intention to stir debate and begin the process of problem definition. This problem cannot be addressed by one community or military occupation specialty alone. Perhaps that is why it is a problem after all.

Special thanks are given to CDR Rick Nagle, USN (Ret.), Mr. Joel Tiller, and Mr. Jeff Geiger who reviewed drafts and provided valuable feedback. Additional thanks are given to CDR Jack James, Officer in Charge EODGRU ONE VSW MCM Detachment, for his continued personal support and leadership in closing a critical gap in the Navy's mine warfare plan.

Abstract

The intended audience for this paper is those individuals with a working knowledge of naval concepts in littoral regions, specifically with reference to amphibious operations in a mine environment. As such, liberty is taken to not fully explain all mine warfare and amphibious terms and concepts referred to within. Basic mine warfare concepts of employment and capabilities are assumed to be within the common knowledge of the reader. Department of the Navy officers, acquisition professionals, government research and laboratory personnel, and defense contractors involved in solving the Navy-Marine Corps challenges in achieving the full intent of *Operational Maneuver From the Sea* are encouraged to discuss the contents and concepts in this paper. The intent of this paper is to explain the problem in marking clear access areas to littoral penetration points in the conduct of amphibious operations in a mine environment and recommend concepts of operations to address existing shortfalls in tactics and equipment. The research methodology used was a combination of MCM operational experience of the author with traditional professional journal and historical documentation research. The findings of this paper should raise the level of understanding concerning the criticality of the current shortfall in lane marking capabilities as it affects operational maneuver doctrine. Recommendations will be presented as the first step in achieving a solution to marking clear access through mined waters to littoral penetration points.

Part 1

Introduction

The end of the Cold War necessitated a change in naval doctrine, as identified in the 1992 Department of the Navy strategic concept paper ... *From the Sea*, away from operations on the sea itself towards power projection from the sea to the littorals. In 1994, *Forward...From the Sea* addressed the specific contributions and emphasis of naval expeditionary forces to achieve national strategic objectives.¹ The change from the Soviet blue water maritime threat to a regional response capability has increased the need for maneuver in the near-shore regions while remaining engaged in forward areas to contain regional disruptions before full-scale conflict develops. If deterrence and diplomacy fail in a region, naval forces must be poised for immediate sea-based response to include forced entry against a denied area.² The ability of maritime forces to seize advanced bases is critical to enabling the flow of follow-on land based air and ground forces from other services and coalition countries.

Publication of *Operational Maneuver From the Sea* (OMFTS) addressed the application of the tenets of maneuver warfare to amphibious operations, allowing rapid maneuver of landing forces from amphibious ships directly to objectives ashore without a break in momentum or establishing an initial beachhead ashore.³

Ship-To-Objective Maneuver (STOM), released in July 1997, continued to refine the discussion and requirements to meet the paradigm shift in naval operations with the new

emphasis on the littorals. It also clearly restated that “forcible entry capabilities are a key element of joint doctrine for force protection.”⁴ In order for this doctrine to work, the sea must remain the essential maneuver space for the landing force from over-the-horizon to ashore, while not restricting movement en route, to allow commanders to “specifically find or create exploitable gaps” to the littoral penetration points.⁵

Although the shift has changed from seizing a beachhead as the objective to crossing a littoral penetration point (LPP) that best supports the mission of each landing element commander, the requirement to reach the beach still exists. The landing force must be able to locate, identify, and avoid natural and manmade impediments to mobility to include obstacles and mines.

“In terms of cost-effectiveness and impact on the littoral environment, mines are the single most attractive weapon available to anyone intent on inhibiting the ability of U.S. Naval Forces to project power from the sea.”⁶ Mine countermeasures readiness has plagued the Navy in a repetitive cycle of increased attention following mine strikes and operational shortfalls, ensued by progressively waning interest in the whole issue of mine warfare. It is important to ensure the capability to counter enemy mining efforts is fully implemented and remains viable. This premise is clearly shown throughout history. Mines have been used in every major U.S. war since the American Revolution.⁷ With the end of the Cold War leaving the United States as the sole superpower, less developed countries will seek asymmetrical advantages through the use of naval mines to limit our control of the maritime environment.

With this paradigm shift in naval operations to support the maneuver doctrine comes changes in weapon system procurement and tactical employment. Procurement decisions for the USMC advanced amphibious assault vehicle (AAAV) and MV-22 Osprey helicopter are

intended to be enablers of the new doctrine. Combined with the landing craft air cushion (LCAC) vehicles of the Navy Assault Craft Units, these innovations link the expeditionary role of the naval service to the ability to use the sea as maneuver space.

Despite the advances in these amphibious enablers and the evolution of doctrine towards maneuver from the sea, a serious deficiency exists within the amphibious task force (ATF) and mine countermeasures (MCM) forces in conducting amphibious operations in a mine environment. Without a system that allows for marking of cleared lanes to the beach, the intent of OMFTS and STOM cannot be implemented and the MCM effort may not translate to an ability to conduct amphibious operations. The reliance on the global positioning system (GPS) system satellite constellation has forced a mandate on this as the navigation source and datum reference for MCM and amphibious operations in the littorals. There is a need to develop a reliable and redundant navigation and lane marking system, independent of GPS, for use within each separate littoral penetration area (LPA) or zone (LPZ).

Resource Investment to Capability Assessment

*The Navy's current MCM capabilities are in a special purpose force that consists of 12 mine-hunter, coastal (MHC) and 14 MCM ships, 1 command and support ship, 24 mine-hunting and clearing helicopters, 17 explosive ordnance disposal detachments, a very shallow water detachment, and a marine mammal detachment. According to the Navy, the cost of operating and maintaining this MCM force from fiscal year 1992 to 2003 will be about **\$1.9 billion**.⁸ (bold emphasis by author)*

—General Accounting Office 1998 report

The Navy has improved capabilities in exploratory and reconnaissance operations in the very shallow water (VSW), shallow water (SW), and deep water (DW) regions following the lessons learned from the Gulf War. The VSW MCM Detachment offers a low visible/low observable capability for non-permissive operations. The permissive environment mine threat is

countered by surface mine countermeasure (SMCM) ships, airborne mine countermeasure (AMCM) helicopters, and underwater mine countermeasures (UMCM) explosive ordnance disposal divers. These assets are trained and equipped to operate in permissive environments only.⁹ However, given the threat scenario, water depth proximity to shoreline, and airspace dominance and employment of operational deception by U.S. and coalition forces, limited mine exploratory and reconnaissance operations can be conducted by these assets in advance of an amphibious assault. These MCM operations could be planned and executed without compromising the littoral penetration sites and littoral penetration points.

The four types of MCM forces listed above possess the ability to conduct four of the five required skills of any mine countermeasures operation. The ability to *search* an area, *locate* mine-like objects and obstacles (natural and man-made), *classify* the objects as mines/obstacles or non-mines, and *identify* the specific threat exists as naval capabilities in the VSW, SW, and DW regions today. The fifth skill, *neutralizing* mines/obstacles in these regions, has posed a greater challenge that is still being addressed. The common denominator for all of these operations conducted to determine the presence or absence of mines/obstacles is the requirement to precisely mark the locations of the hazards when found. Of even greater importance to the landing force is the ability to mark the clear ingress and egress paths to the beach.

Neutralization can be delayed until after the amphibious assault if sufficient clear routes to the beach are found prior to the assault. Given the need to maintain the element of surprise and momentum when assault forces are moving from the line of departure to the specific littoral penetration points, it is imperative to prevent an operational pause in the execution of an assault. For this reason, the complex task of neutralizing mines and obstacles concurrent with assault maneuver should be relegated to the future when advanced technology presents solutions to

allow neutralization to occur during movement to the beach. Significant efforts by acquisition agencies, government contractors, and military personnel will eventually solve the neutralization problem.

The surf zone (SZ) region is not an MCM effort area in which the “search, locate, classify, identify, and neutralize” sequence applies. Rather, the surf zone is breached by brute force, without the same precursor MCM reconnaissance effort to find a gap in the enemy defenses. The MCM effort in DW, SW, and VSW will aid in planning the location of the SZ breach, assuming clear lanes through mined areas to the SZ are appropriately marked.

Given the volatility of the littoral regions, the naval service needs a coordinated VSW, SW, and DW MCM reconnaissance capability today until the neutralization problem is solved in these areas. The capacity to detect the presence or absence of mines and obstacles in the littorals exists, but with a critical shortfall. The shortfall lies in ensuring the assault forces know the clear routes to the beach and the areas with mines and obstacles that must be avoided. In this manner, the current exploratory and reconnaissance MCM capabilities of VSW, AMCM, SMCM, and UMCM assets cannot be translated to a tangible risk mitigation for the assault forces without a lane marking capability. A clear lane, not properly marked for the landing force, is not a safe route through the littorals. Lane marking is a critical enabler for amphibious operations. Herein lies the shortfall. Once the neutralization capability is realized, unencumbered maneuver to the beach will not be deterred by the presence of mines and obstacles. Lane marking capability improvements are needed today and will further enhance operational maneuver in the future when neutralization is achieved.

Investment reallocation toward development of a capability to solve the littoral penetration area lane marking problem will greatly improve the ability to implement *Operational Maneuver*

From The Sea and Ship to Objective Maneuver concepts today. When future research and technology developments present solutions to the neutralization problem to allow forced entry into areas of known mine locations, lessons learned from investing today in lane marking will only serve to improve future MCM and amphibious capabilities.

Notes

¹ United States Department of Defense. *Forward...From the Sea*. (Washington, D.C.: Office of the Chief of Naval Operations, 1994), 2.

²Ibid, 3.

³ United States Department of Defense. *Operational Maneuver From the Sea*. (Washington, D.C.: Commandant of the Marine Corps, 1994), 6.

⁴ United States Department of Defense. *Ship to Objective Maneuver*. (Washington, D.C.: Commandant of the Marine Corps, 25 Jul 97), II-3.

⁵ Ibid., II-9.

⁶ United States Department of Defense. *United States Naval Mine Warfare Plan. Fiscal Year 1996-1997 Programs*. (Washington, D.C.: Office of the Chief of Naval Operations, 1996), 3.

⁷ Gregory K. Hartmann and Scott C. Truver,, *Weapons That Wait. Mine Warfare in the U.S. Navy*. (Annapolis, MD: Naval Institute Press, 1991), 14.

⁸ General Accounting Office, *Report to Congress on Navy Mine Warfare: Plans to Improve Capabilities Unclear*. (Washington, D.C., June 10, 1998), 4.

⁹ *United States Naval Mine Warfare Plan. Fiscal Year 1996-1997 Programs*.

Part 2

Current Lane Marking Capabilities and Shortfalls

Military units have developed an increasing reliance on GPS-based systems for a full range of uses from peacetime operations to major regional conflict. Assuming the possibility for system degradation, local area jamming of the system, or inoperable unit-level GPS receiving equipment, a requirement exists for a GPS independent system in the conduct of amphibious assaults. The system must provide positional location of assault craft transiting from amphibious task force (ATF) ships and the line of departure (LOD) to objectives ashore, while avoiding mine and obstacle hazards.

The current navigation system for use in amphibious operations is the Breach Lane Navigation Beacon (BLN). The BLN is a man-portable beacon that provides accurate visual aid to straight-line navigation along a predetermined course.¹ It produces high-intensity, color-coded beams of light used for reference by the landing craft within a narrow zone, extending to a distance of 1.0 nautical mile visibility with the unaided eye. The filter colors, as viewed looking toward the light, are green on the left and red on the right. Each colored beam is three degrees wide. Refer to Figure 1 for diagrams depicting system operations. Navy Beachmaster personnel, who deploy and operate the system, are limited to permissive environments only. The BLN is placed ashore at the craft landing site with accurate positioning provided by a hand-held Global Positioning System unit.² The BLN is aimed along a specified magnetic bearing using

the unit's compass. Some of the employment shortfalls that have been identified regarding the BLN are addressed in the next section.

Shortfalls with the BLN and Concept of Operations

- BLN has a visual range that extends to one nautical mile only. This capability is advantageous for the period just prior to crossing the littoral penetration point (LPP). However, it will not provide clear lane navigation reference beyond one nautical mile. As such, depending on the depth contours, the BLN may only provide a reference for landing craft transiting the VSW/SZ region and not the SW or DW. As found in amphibious objective areas with a shallow gradient such as the Arabian Gulf, this system will leave much of the mined transit area without a visual navigation reference.³
- The BLN must be placed on the shore of the denied area prior to the actual assault, raising numerous questions and tactical employment issues in forced-entry non-permissive environments that are fundamental to the concepts in OMTFS and STOM. Even if advance forces could emplace the beach units, the lane marking device could be disabled by the hostile force and likely compromise the LPP.⁴
- As shown in Figure 1, the width of the referenced lane narrows with proximity to shore, severely limiting the ability of the landing craft to maneuver within the actual cleared lane in response to opposition fires.⁵
- Positioning of the BLN ashore requires a GPS handheld unit, relying on GPS coverage at the time of emplacement. An error induced by a GPS figure of merit degradation at the time of emplacement would compound error in the arc of the light.⁶
- The BLN capability restricts reference to a single straight-line approach along the magnetic bearing of the light source, thereby limiting the landing craft's movement within the referenced bearing. In addition, the STOM concept stipulates numerous locations for crossing LPPs.⁷ This requires the emplacement of numerous BLN systems, creating a high probability of ambiguity for the landing craft coxswains attempting to differentiate among the different light sources.⁸
- A small lateral offset error in magnetic bearing translates to a large cross-track error at the seaward limit of visibility.

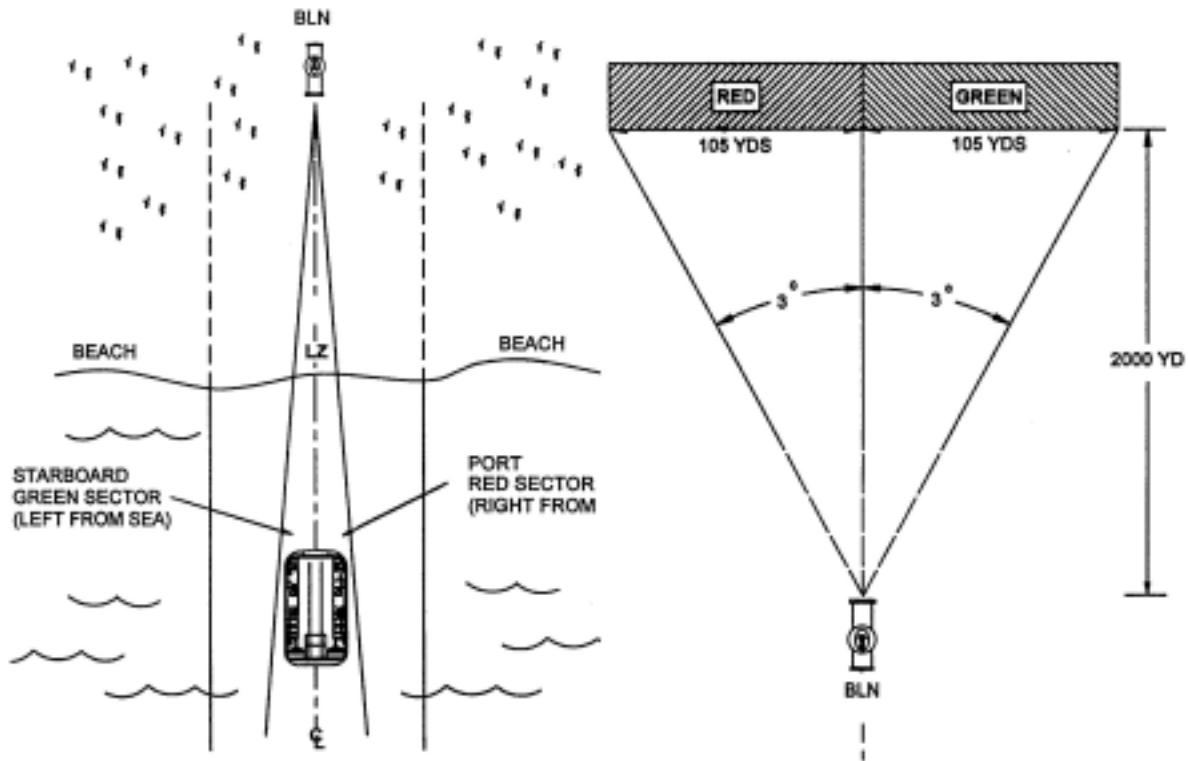


Figure 1. BLN System Operation

These shortfalls are serious, but not universally recognized within the Department of the Navy, and indicative of larger organizational problems in amphibious warfare. The lane marking task has not been assigned as a specific responsibility. There is a common perception that the task is simple and will not be a problem when actual operations require the capability. Both of these problems have serious implications to the implementation of operational maneuver in amphibious operations.

Additionally, the BLN was designed only as a terminal guidance visual aid for LCAC personnel. Although it is a critical part of the answer to over-the-horizon amphibious assault, BLN was not intended to meet the full requirements of *Ship to Objective Maneuver*. The BLN actually predates the STOM concept. A look at timelines validates this premise. The BLN was an ACAT IV acquisition program that achieved Milestone III in September 1995 with

procurement of fifty units in fiscal year 1996.⁹ The Commanding General, Marine Corps Combat Development Command signed STOM in July 1997.¹⁰

Notes

¹ United States Department of Defense. *Beacon, Navigation, Breach Lane, Mk 7 Mod 0 Preliminary Technical Manual*. (Commander, Naval Sea Systems Command, 01 June 1997), 1-1.

² *Beacon, Navigation, Breach Lane, Mk 7 Mod 0 Preliminary Technical Manual*., 1-1.

³ *Ibid*, 1-6.

⁴ *Ibid*, 1-1.

⁵ *Ibid*, Figure 1-1.

⁶ *Ibid*, 1-4.

⁷ United States Department of Defense. *Ship to Objective Maneuver*. (Washington, D.C.: Commandant of the Marine Corps, 25 Jul 97), II-3.

⁸ *Beacon, Navigation, Breach Lane, Mk 7 Mod 0 Preliminary Technical Manual*, 2-1.

⁹ *United States Naval Mine Warfare Plan*, 37.

¹⁰ United States Department of Defense. *Ship to Objective Maneuver*. (Washington, D.C.: Commandant of the Marine Corps, 25 Jul 97).

Part 3

Lane Marking Alternatives and Concept of Operations

General Requirements

This section is a general description of lane marking requirements in the littorals derived from source references supporting the Navy's *Forward...From the Sea* and the Marine Corps' *Ship-to-Objective Maneuver* operational concepts. Additionally, the Shallow Water Marking Operational Requirements Document (although dated in 1994, prior to the operational concept documents) was used to bound the requirements.

The concept of operations for a littoral lane marking system should meet three basic requirements. First, it should be simple to employ, operate, and maintain. Second, it should be reliable through a concept of redundancy to compensate for unit failures. Finally, it must be precise. Errors in location in a known minefield can be fatal and lead to mission failure during an amphibious assault.

During the Russo-Japanese War of 1904, the Japanese Navy used floats (referred to as “dan buoys” today) to mark the swept channel through a Russian minefield. Acting on the knowledge that the Japanese Navy relied solely on these buoys for safe navigation through the minefields, the Russians secretly relocated the buoys. Three Japanese cruisers were damaged from mine strikes due to the assumption that the floats marked a clear path.¹

Lane marking systems must be interoperable with the amphibious task force, carrier battle group (with organic MCM assets), dedicated MCM forces (AMCM, SMCM, UCMCM, and VSW assets), and the assault breaching forces. In preparing the battle space in advance of an amphibious assault, the number of sensors that will be employed in the various zones (SZ, VSW, SW, and DW) will mandate that all information is presented via a common tactical picture.²

This is done today in CVBG, ATF, and MCMRON assets with information systems such as Mine Warfare Environmental and Tactical Decision Aid Library (MEDAL), Joint Tactical Information Dissemination System (JTIDS), and the Global Command and Control System (GCCS). Despite this, the assault forces do not have these types of complex systems on landing craft (AAV, LCAC, LCU, AAV) and need to rely on a simple visual reference. Additionally, GCCS and MEDAL are GPS-referenced systems.³ A need exists to have a littoral minefield marking and transit system that is not solely dependent on GPS.

“The shallow and very shallow water regions impact overall expeditionary warfare operations – specifically amphibious operations—the most.”⁴

—United States Naval Mine Warfare Plan

An emphasis on developing the final aspect of transiting mined waters—a navigation system serving the VSW/SW areas—will allow a significant improvement in amphibious capability. This capability will prove as fundamental to the OMTFS and STOM concepts as the procurement of other new systems like the AAV and MV-22.

Notes

¹ Arnold S. Scott, *Most Dangerous Sea. A History of Mine Warfare, and an Account of U. S. Navy Mine Warfare Operations in World War II and Korea.* (Annapolis, M.D.: U.S. Naval Institute Press, 1959), 62-3.

² *United States Naval Mine Warfare Plan*, 70.

³ *Ibid*, 70.

⁴ *Ibid.*, 2.

Part 4

Proposed Concepts for Littoral Lane Marking

Littoral lane marking is a critical enabling system for amphibious operations.

As such, the acronym for this system should convey its intended purpose. The **Littoral Minefield Marking and Transit System (LIMITS)** will serve as the bridge between the line of departure and the littoral penetration points as assault forces maneuver safely, within the **limits** of cleared access, through a minefield to objectives ashore. This part presents three alternatives in concepts of employment and provides recommendations for their characteristics based on a review of amphibious doctrine publications and mine warfare acquisition requirements documents.

Concept One: Electronic Gridline

This first concept can be implemented in a variety of ways, but the concept remains the same. Before MCM and ATF units arrive to commence operations, an electronic gridline could be established within the confines of planned littoral penetration areas or zones, depending on the geographic size of each. Before operations commence, the electronic gridline would be established with predetermined reference points. The reference points should frame the battle space with respect to the seaward limits of mine-able waters (determined by water depth and enemy order of battle) or seaward limits of landing craft vulnerability (target craft to mine sensor

depth dependent). Additionally, the reference points should encompass the extreme left and right flanks within the LPA/LPZ to maximize the area of unencumbered maneuver space. The electronic gridline would be established with precise means through GPS (if presently available) or a visual navigation aid triangulation method. Once the reference points are established and the gridline is in place, all dedicated and organic MCM effort should be in relation to the gridline. Assuming the NAVSTAR GPS system remains in a full operational capable status, MCM efforts within the electronic gridline can be marked with the redundancy of using both GPS and electronic gridline referenced positions.

A question that arises pertains to the means of establishing the gridline: radio frequency, acoustic, magneto inductive, etc. The specific technology to implement such a system will be found once the acquisition requirement is defined. The issue is to establish an electronic gridline reference system that can work with or independent of GPS systems. The system will frame the LPA/LPZ area of interest. The system should be simple and reliable, with redundancy inherent in the number of reference stations. It should be capable of minimizing jamming and interference from enemy electronic warfare assets through methods such as frequency hopping, sufficient signal strength, and transmitting only when interrogated, for example.

The Very Shallow Water Mine Countermeasures (VSW MCM) Detachment employs a similar concept for small area diver operations that was developed by Naval Surface Warfare Center (Coastal Systems Station) Panama City, Florida. The Swimmer Inshore Navigation System (SINS) utilizes a long baseline acoustic transmitter system. Divers in combat rubber raiding craft (CRRC) use handheld GPS receivers to place two SINS underwater transmitters just above the seabed in precise locations determined during pre-mission planning. Acoustic signals sent from the two transmitters are received by divers via handheld units during reconnaissance

operations in the area of interest. An X-Y gridline is established with the X-axis parallel and the Y-axis perpendicular to the shore. The SINS system is GPS-independent once established. It is simple and reliable. The cost of such a system is approximately \$100K¹. This provides for a comparison, in order of fiscal magnitude, with other multi-million dollar acquisition efforts such as AAAV and MV-22.

A similar system employed in the larger LPA/LPZ area (vice just the VSW diver area) would allow all dedicated and organic MCM assets to leverage collective efforts as clear lanes are sought to the LPPs. The acoustic transponder method used for the system at the VSW MCM Detachment illustrates both a sound concept and one means of accomplishing a reference system independent of constant GPS coverage. Divers or other Special Forces could place the beacons for this system. However, given recent changes in technology, small, low-cost autonomous surface or underwater vehicles with precise navigation capabilities may be a feasible alternative approach to delivery platforms for establishing the grid system. ²

Concept Two: Unmanned Undersea Vehicle Lead-Through

Traditional mine countermeasures operations for surface ships employs a concept known as lead-through. The notion is associated with a minesweeper/minehunter leading a larger warship in or out of mined waters to an area of free maneuver. An example would be an Avenger-class MCM ship lead-through of an Arleigh Burke destroyer from a harbor, through a channel, to open water.³ Translating this traditional mine warfare concept to the lane marking problem using emerging technology presented by unmanned underwater vehicles (UUV) yields a possible solution. After VSW, SW, and DW MCM assets have prepared the assault area and the safest routes to the LPPs are established, UUVs could be programmed to follow pre-designated routes through the mined areas⁴. Assault forces would follow the UUVs via station keeping astern and

make course changes based on the movement of the UUV towards the beach. There are a wide variety of methods that could be employed to maintain visual contact with a UUV lead-through asset. Some are presented here.

- Radar reflecting capability. For day or night maneuver, the UUV could maintain a surface depth and utilize a mast-mounted radar reflecting device such as a diablo. A similar procedure has been employed to vector EOD divers in small boats by using an in-water diablo and a MCM ship's sonar to direct the boat to a minelike contact⁵. As such, the landing craft, utilizing a surface-search radar (like the LN-66 on the LCAC) could maintain relative bearing position and distance from the UUV as progress towards the LPP is made.
- Visual or infrared spectrum lighting. For night maneuver, the UUV could again maintain a surface depth and utilize a mast to augment the display with a light source. An onboard compass could be used to illuminate in a direction away from the LPP (back azimuth) ingress bearing to limit detection from shore. Additionally, the light source can illuminate a predetermined sector arc to ensure the landing craft stays within a determined relative position arc behind the UUV. In this manner, as the landing craft began to drift out of position from behind the UUV, the light source could either dim or change color to indicate that the landing craft was heading towards mined areas.
- Directional beacon reference display. For day or night maneuver, the UUV leading the landing craft to the LPP could employ an active transmitter emitting a signal to a receiver onboard the landing craft. The receiver could be programmed for specific tolerances of bearing and range that would be presented as a visual display on a screen in the landing craft. As the position of the landing craft moved in relation to the determined position, visual inputs from the display and audible alarms would indicate the corrective action required. In this manner, a coxswain would use a screen to maintain station astern of the UUV, programmed with an ingress course that avoids mined areas and make course changes per the safe route ashore.

The UUV lead-through concept would not require MCM or ATF personnel to place the UUV in the amphibious assault area prior to the intended movement ashore. This would preserve the element of surprise and allow for last minute programming of the UUV as the planning of amphibious routes is finalized. However, given the need to have a system that is independent of GPS, the UUV reference navigation system would need to be addressed. If GPS was available, the use of GPS latitude and longitude way points would allow for pre-mission

planning and programming of the UUV, with landing craft navigators also knowing the intended routes in GPS datum points. This could not be the sole method, given the assumption of GPS denial/degradation, but would still be a reasonable tool for route planning. A redundant method of navigation must be developed to ensure precise movement through the mined areas in relation to the MCM search/clearance effort. Bottom lock doppler velocity log (DVL) and inertial navigation systems (INS) are emerging technologies that offer potential precise navigation alternatives to GPS and other external reference precise navigation systems.⁶

Options for UUV navigation

- Utilize an electronic system as previously described in concept one. The electronic gridline would provide reference points for the UUV as it followed the predetermined course to the LPP. In this manner, both the UUV and landing craft would receive the signal. The landing craft coxswain would then follow the UUV as a primary visual reference source and utilize onboard receiving equipment as a secondary means of navigation.
- The UUV navigation could be based on precise reference to acoustic transmitters placed on the sea bottom in the mined areas. Divers from the VSW MCM or UMCM Detachments, or small autonomous underwater vehicles, could be given datum points to place the acoustic transmitters for a specific cleared route or to establish a box area within which the UUV could maneuver.⁷ The UUV would utilize an algorithm that calculated the bearing, distance, and slant range to each transmitter in relation to the planned route as it proceeded along the predetermined path to the beach. Acoustic propagation in the near-shore regions and station keeping of transmitters in the high current and surge inherent in the littoral area are challenges to this concept. The concept of employment has been proven on a smaller scale for VSW divers conducting mine/obstacle searches in the very shallow water (40-10 foot) region.⁸

Concept Three: Submerged buoy activated surface markers

Utilize delayed rising buoys that lie dormant on the sea floor until activated by a command signal. The signal would be sent as the landing forces begin movement from the line of departure. The buoys would then rise to the surface and visually mark the lanes to the littoral penetration points. A variety of options are possible with respect to colors of buoys, light

emitting sources, radar-enhancing reflectors, etc. The buoys could be placed in order to form left and right boundaries of cleared approach lanes. Alternatively, they could be placed along the centerline of a cleared lane with the safe width of the cleared lane given to the landing force. Aside from marking transit lanes, markers could also be placed to mark mine danger areas and specific obstacles that might impede operational maneuver. For reduced visibility, radar reflectors and/or lights could be used to allow redundant visual recognition methods. The buoys would need to be of minimal size and weight to allow for diver emplacement, while being of sufficient size to be seen by landing craft. Divers, operating in a low-visible manner, would be required to place the buoys in the waters near the shore in order to preserve concealment of the landing site. Emplacement further at sea could be done by small boat in the hours before a landing.

Some method of inflation, such as command-actuated CO2 cartridges, would be required for inflation of the diver placed lane marking buoys. A self tensioning mooring line would also be required to ensure the buoys maintained position over the anchor and did not reflect error from tidal change and excessive mooring line that allowed positional surface drift within a watch circle. With a buoy system, lights would need to be omni-directional, as it would be difficult to only illuminate in a direction pointing away from the shore. An infrared system could be used as the light source to reduce enemy detection possibility. Although a buoy system would be relatively simple, it may be vulnerable to deflation from friendly or hostile fire.

Notes

¹ Capt Adin Pfueffer, USMC, Operations Officer, EODGRU ONE VSW MCM Detachment, interviewed by the author, 01 Apr 2000.

² United States Department of Defense. *Rapid, Organic, Standoff Technologies for Breaching Surf Zone and Beach Mine Zones and Obstacles (BAA-00-002)*. Office of Naval Research. Available online. Internet.
http://www.onr.navy.mil/sci_tech/baa/mcmbaa99/default.asp.

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³ LCDR Jason Gilbert, USN, EOD Exercises Officer, Commander, Mine Countermeasures Squadron ONE, interviewed by the author, 12 March 2000.

⁴ CDR Rick Nagle, USN (Ret.), former OPNAV N852F Mine Warfare Requirements Officer, interviewed by the author 01 March 2000.

⁵ LCDR Jason Gilbert, 12 March 2000.

⁶ CDR Rick Nagle, 01 March 2000.

⁷ Capt Adin Pfeuffer, 01 Apr 2000.

⁸ Ibid.

Part 5

Recommendations and Conclusions

Recommendation #1: Reassess Resource Allocation.

The Director, Expeditionary Warfare Division (CNO N85) within the office of the Chief of Naval Operations, and the Commander, Mine Warfare Command (CMWC) have overseen the development of viable MCM exploratory and reconnaissance capabilities for use in the deep, shallow, and very shallow water regions.¹ The harder aspect from acquisition efforts and unit level proficiency remains the capability to neutralize mines and obstacles found in reconnaissance/search operations.

Significant fiscal resources and research efforts are being applied to address the neutralization challenge. The Office of Naval Research (ONR) has recently solicited industry for innovative concepts that can improve upon VSW and surf zone assault breaching. ONR has programmed \$30M dollars over the next three years (beginning in June 2000) to demonstrating technology solutions.² The assault breaching project office within the Surface Mine Countermeasures program office (PMS-407) has programmed funding for advanced development of systems beginning in FY 2004, using successful solutions from the ONR Broad Agency Announcement technology demonstration efforts.³

Solutions for neutralization for mid- and far-term dates may emerge. However, there is not an answer for the near term. While the ONR and PMS 407 programs focus primarily on

breaching, lane marking solutions are also being included in the development objectives. It is not yet clear whether programmed resources are adequate to solve the fundamental problem of lane marking for the non-mined littoral regions.

The General Accounting Office reported in 1998 that \$1.2 billion in RDT&E funds has been expended to improve Navy mine warfare capabilities since the Gulf War and that \$1.5 billion is programmed for the next six years.⁴ The report also highlighted the fact that 28 separate MCM development programs and several advanced technology and capability demonstration initiatives were ongoing. However, none of these efforts addressed the lane marking problem.⁵ An investment in resource allocation and renewed emphasis on lane marking by CNO N85 and CMWC would pay significant dividends towards the implementation and execution of *Operational Maneuver From the Sea* and *Ship to Objective Maneuver* concepts. The emphasis and resources must be sufficient and commensurate with the importance of the lane marking shortfall.

Recommendation #2: Capitalize on Capabilities.

As previously discussed, a common tactical approach is used in mine countermeasure/countermine operations. An MCM operation proceeds in the following phases: search, locate, classify, identify, and then, neutralize (if directed). The U. S. Navy has invested heavily (as shown in the GAO report to Congress) in mine warfare forces following the lessons learned from the Gulf War. As such, the return on the investment has resulted in steady improvements in the Navy's capabilities to accomplish the first four of these phases (search, locate, classify, and identify) for the deep, shallow, and very shallow water regions.⁶ Neutralization, on the other hand, remains a technological challenge. The ability to fully capitalize on the MCM investment returns and enhanced capabilities in search, locate, classify,

and identify phases will be hindered without the delivery of a more robust and effective means of lane marking to guide amphibious and MCM forces in the littoral battlespace. Achievement of a littoral lane marking capability is the first step in the transition of naval forces from traditional attrition warfare concepts for amphibious operations to OMFTS and STOM concepts in a mine environment. The combination of capabilities in “search, locate, classify, and identify” coupled with an ability to navigate lanes yields a viable amphibious MCM system capability, despite the current deficiencies in neutralization capability. Additionally, even when the neutralization problem is solved, the requirement will still exist to mark the lanes cleared by neutralization methods.

Recommendation #3: Ownership of the Lane Marking Mission.

Fundamental to success in any endeavor is ownership. When Admiral Boorda identified problems in the VSW zone and established the Very Shallow Water Mine Countermeasures Detachment in Coronado, CA, ownership of the tactics, techniques, and procedures was assigned to the warfighting laboratory he created. The Sailors and Marines were empowered to find solution to the VSW MCM deficiency.⁷ The Program Executive Office, Mine Warfare (PMS-EOD) was empowered to field new tools for evaluation at the “deckplate” level, allowing the owner-operator to directly interface with industry and the acquisition community.⁸ People remain the key to acquiring new capabilities to resolve long-standing warfare deficiencies in national defense

Ownership of a lane marking system by a single acquisition office with the sponsoring resource manager would be the first step to ensure both accountability and consistency in addressing the current deficiency. Because the ability to mark cleared littoral areas transcends warfare communities (mine warfare, amphibious warfare, special warfare) and service

components (Navy and Marine Corps), ownership has not been properly identified. The roles and missions related to lane marking are unclear in doctrine today. Whether USMC combat engineers, USN Assault Craft Units, Explosive Ordnance Disposal technicians, Marine reconnaissance divers, or other amphibious and mine countermeasures forces have responsibilities in this mission is subject to debate and interpretation.

A team of a resource sponsor, program office, developing agency and Fleet user should be assigned ownership of the mission and provided the means to develop, acquire, and field the solution. With ownership comes attention to resource allocation and requirements specifications. Aggressive ownership of the lane marking shortfall by CNO N85 and liaison with Amphibious and Mine Countermeasure Squadron staffs to reassess requirements for lane marking as a core competency of amphibious operations is recommended. In a 1998 report to Congress, the General Accounting Office stated:

“What is required is for the Navy leadership and the various warfare communities to agree on the composition and structure (size) of future MCM forces and commit the necessary resources to their development and sustainment. The intent of our matters for consideration is to give additional attention to the sufficiency of budget resources the Navy has devoted to MCM.”⁹

The aforementioned multi-warfare community nature of lane marking has created a diffusion of responsibility and a systemic lack of ownership that must be addressed to correct the overall lane marking shortfall.

Recommendation #4: Rewrite the SWMCM ORD (Marking Annex)

“We can ill afford to move 3,000 miles to theater and be stymied by mines and obstacles in the last 3,000 yards.”¹⁰

—Maj Gen Rhodes, USMC, Marine Corps Combat Development Command

The comment by General Rhodes emphasizes the importance of the MCM effort and applies equally well to a lane marking capability. The Shallow Water Mine Countermeasures Marking Operational Requirements Document (SWMCM ORD) is outdated.¹¹ A thorough review with respect to the evolution of capabilities in MCM and assault breaching forces, with senior leadership vision as outlined in OMFTS/STOM, will serve as a solid foundation for renewed emphasis to this aspect of amphibious operations. The *Marine Corps Master Plan* (MCMP) contains the required capabilities of the expeditionary force. MCMP Required Capability #2 defined the requirement for: “The detection, recording, marking, and clearing of lanes from deep through shallow water mined areas.”¹² Given this high priority emphasis in the MCMP, it is necessary to have an updated requirements document, which reflects capabilities and direction in the near-, mid-, and far- term.

Conclusion

According to Lieutenant General Charles E. Wilhelm, USMC (Ret), in a *Marine Corps Gazette* article, “*For openers, minefields are not perfect. There will be gaps...These are the gaps we must find and exploit.*”¹³ His comments ring true, especially given the change in maneuver warfare envisioned in *Operational Maneuver From the Sea*.

Due to enlarging the littoral region by including numerous littoral penetration points and the fundamental paradigm shift away from linear movement to the beach as seen in the amphibious operations of World War II, enemy coastlines will have exploitable gaps. The U. S. Navy’s MCM forces have the capability to locate these gaps. If access to the littorals depends on solving the mine problem, today’s naval service has that capability.

The final piece of the puzzle is a littoral lane marking system that can be used by all maritime forces operating in a littoral penetration area prior to an assault. With this piece, the

Navy-Marine Corps team will ensure that it meets the mandate of immediate sea-based response to crises, to include forced entry into denied coastal areas. Lanes marking is a critical enabler for amphibious operations, regardless of whether the Navy has a neutralization capability or not. We should not be stymied by the use of mines by an adversary. However, just as important, we should not be stymied by our own inability to recognize and correct a critical operational shortfall in naval amphibious operations in a mine environment.

Notes

¹ *United States Naval Mine Warfare Plan*, 3.

² *Rapid, Organic, Standoff Technologies for Breaching Surf Zone and Beach Mine Zones and Obstacles (BAA-00-002)*. Office of Naval Research. Available online. Internet. <http://www.onr.navy.mil/sci-tech/baa/mcmbaa99/default.asp>.

³ CDR Rick Nagle, 01 March 2000.

⁴ *Report to Congress on Navy Mine Warfare*, 3

⁵ *Ibid*, 3.

⁶ *Ibid*, 3.

⁷ CDR Jack James, USN, Officer in Charge, EODGRU ONE VSW MCM Detachment, interviewed by the author, 01 April 2000.

⁸ CDR Rick Nagle, 01 March 2000.

⁹ *Report to Congress on Navy Mine Warfare*, 7-9.

¹⁰ Rhodes, J. E. Lt. Gen. (USMC), Commanding General, Marine Corps Combat Development Command, to Chief of Naval Operations (N81), subject: Amphibious Counter-Mine and Counter-Obstacle Requirements in support of Operational Maneuver from the Sea, 25 Mar 99, 2.

¹¹ United States Department of Defense. *Operational Requirements Document for Shallow Water Mine Countermeasures Marking*. Washington, D.C.: Office of the Chief of Naval Operations, Expeditionary Warfare (CNO N85), 11 April 1994. (Confidential) Information extracted is unclassified.

¹² *Ibid.*, Enclosure (1), 2.

¹³ Wilhem, Charles E. LtGen (USMC), "Forward...From the Sea: The Mine Warfare Implications," *Marine Corps Gazette*, July 1995, 25.

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